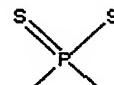
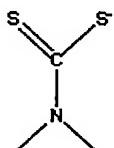
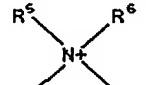


What is claimed is:

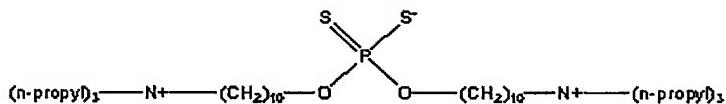
1. A surfactant compound of the formula:
 5 $[X-L-Z-L'-X'] \ (A)_p$,
- wherein X and X' represent outer head groups, which may be the same or different and comprise charged moieties selected from the group of $-N^+R^1R^2R^3$, R¹, R² and R³ being
 10 the same or different and representing hydrocarbyl groups, $-CO_2^-$ or $-O(CH_2)_mSO_3^-$, m being an integer from 2 to 30, or polar moieties of the formula, $-O-(CH_2CH_2O)_n-R^4$, R⁴ being hydrogen or a C₁-C₆ hydrocarbyl group and n is an integer from 1 to 1000; L and L' are the same or
 15 different and represent a hydrocarbon linking moiety which may optionally be interrupted with oxygen; Z represents a central head group selected from a
- dithiophosphate moiety,  , a dithiocarbamate
 moiety,  , or a quaternary ammonium moiety,  ,
 20 wherein R⁵ and R⁶ are the same or different and represent C₁-C₆ hydrocarbyl groups, with the proviso that when Z represents said dithiocarbamate moiety or said quaternary ammonium moiety, X and X' do not represent $NR^1R^2R^3$, and with the further proviso that X and X' do
 25 not represent $-O(CH_2)_mSO_3^-$ unless Z represents said quaternary ammonium moiety; and A represents a counter ion, which may be either positive or negative depending on the net charge of $[X-L-Z-L'-X']$ and p is an integer which, when multiplied by the valency of said counter
 30 ion yields the absolute value of the net charge of $[X-L-Z-L'-X']$.

2. The surfactant of claim 1, wherein said central head group Z represents said dithiophosphate moiety, said linking moieties L and L' are the same and
 5 represent a straight or branched chain hydrocarbyl group having 6 to 30 carbon atoms and said outer head groups X and X' are the same and represent -NR¹R²R³, -CO₂⁻ or -O-(CH₂CH₂O)_nR⁴, R¹, R² and R³ being the same or different and representing hydrocarbyl groups, R⁴ being a hydrogen
 10 or a C₁-C₆ hydrocarbyl group and n is an integer from 1 to 1000.

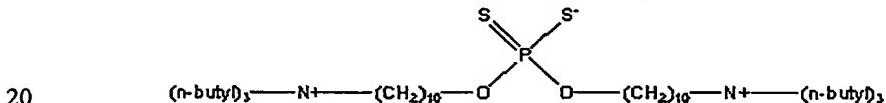
3. The surfactant of claim 2, wherein R¹, R² and R³ represent propyl or butyl groups.

15

4. The surfactant of claim 2 having the formula:



5. The surfactant of claim 2 having the formula:



6. The surfactant of claim 1 wherein said central head group Z represents said dithiocarbamate moiety, said linking moieties L and L' are the same and represent a
 25 straight or branched chain hydrocarbyl group having 6 to 30 carbon atoms or a straight or branched chain hydrocarbyl group having 6 to 30 carbon atoms which is interrupted with oxygen, and said outer head groups X and X' are the same and represent -CO₂⁻ or
 30 -O-(CH₂CH₂O)_nR⁴, R⁴ being a hydrocarbyl group and n is an integer from 1 to 1000.

7. The surfactant compound of claim 1 wherein said central head group Z represents said quaternary ammonium moiety, said linking moieties L and L' are the same and
5 represent a straight or branched chain hydrocarbyl group having 6 to 30 carbon atoms and said outer head groups X and X' are the same and represent $-O-(CH_2)_3SO_3^-$ or $-O(CH_2CH_2O)_nCH_3$, n being an integer from 1 to 1000.
- 10 8. A process for the chemical decontamination of mustard (i.e. $ClCH_2CH_2SCH_2CH_2Cl$), said process comprising reacting said mustard with aggregates of at least one surfactant compound of claim 1, wherein said central head group is a dithiophosphate moiety or a
15 dithiocarbamate moiety, under conditions causing a residue of said mustard to be chemically bound to said surfactant compound, thereby decontaminating said mustard.
- 20 9. The method of claim 8, wherein said reaction is conducted in an aqueous medium and after the occurrence of said reaction the aggregates of said at least one surfactant compound are separated from said aqueous medium.
- 25 10. The method of claim 9, wherein said separation is effected by filtration.
11. A method for controlling release of a material
30 contained within an aggregated surfactant, said method comprising:
a. providing an aggregated surfactant composed of at least one surfactant compound, as claimed in

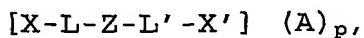
claim 1, wherein said central head group is a dithiophosphate moiety or a dithiocarbamate moiety, said material being in the aggregated surfactant; and

5 b. oxidizing said aggregated surfactant, thereby forming a disulfide-linked dimer from said surfactant compounds and releasing said material from said aggregated surfactant.

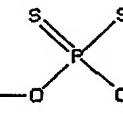
10 12. The method of claim 11, wherein said aggregated surfactant is composed of at least one surfactant compound wherein said central head group Z represents said dithiophosphate moiety, said linking moieties L and L' are the same and represent a straight or branched
15 chain hydrocarbyl group having 6 to 30 carbon atoms and said outer head groups X and X' are the same and represent -NR¹R²R³, -CO₂⁻ or -O-(CH₂CH₂O)_nR⁴, R¹, R² and R³ being the same or different and representing hydrocarbyl groups, R⁴ being a hydrogen or a C₁-C₆ hydrocarbyl group
20 and n is an integer from 1 to 1000.

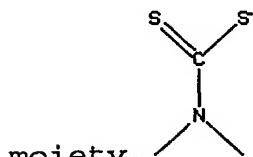
13. The method of claim 11, wherein said aggregated surfactant is composed of a surfactant compound wherein said central head group Z represents said
25 dithiocarbamate moiety, said linking moieties L and L' are the same and represent a straight or branched chain hydrocarbyl group having 6 to 30 carbon atoms or a straight or branched chain hydrocarbyl group having 6 to 30 carbon atoms which is interrupted with oxygen and
30 said outer head groups X and X' are the same and represent -CO₂⁻ or -O-(CH₂CH₂O)_nR⁴, R⁴ being a hydrogen or a C₁-C₆ hydrocarbyl group and n is an integer from 1 to 1000.

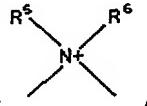
14. A process for removing heavy metal ions from a liquid medium containing said ions, said process comprising adding to said liquid medium a surfactant 5 compound of the formula:



wherein X and X' represent outer head groups, which may 10 be the same or different and comprise charged moieties selected from the group of $-N^+R^1R^2R^3$, R¹, R² and R³ being the same or different and representing hydrocarbyl groups, $-CO_2^-$ or $-O(CH_2)_mSO_3^-$, m being an integer from 2 to 30, or polar moieties of the formula $-O-(CH_2CH_2O)_n-R^4$, 15 R⁴ being hydrogen or a C₁-C₆ alkyl group and n is an integer from 1 to 1000; L and L' are the same or different and represent a hydrocarbon linking moiety which may optionally be interrupted with oxygen and Z represents a central head group selected from a

20 dithiophosphate moiety,  , a dithiocarbamate



moiety,  , or a quaternary ammonium moiety, 25 wherein R⁵ and R⁶ are the same or different and represent C₁-C₆ hydrocarbyl groups, with the proviso that when Z represents said dithiocarbamate moiety, X and X' do not represent $NR^1R^2R^3$, and with the further proviso that X and X' do not represent $-O(CH_2)_mSO_3^-$ unless Z represents said quaternary ammonium moiety; and A represents a counter ion, which may be either positive or negative depending on the net charge of [X-L-Z-L'-X'] and p is an 30 integer which, when multiplied by the valency of said

counter ion yields the absolute value of the net charge of [X-L-Z-L'-X'], said surfactant compound being added to said liquid medium in an amount effective to form aggregates comprising said surfactant compound complexed 5 with said heavy metal ions; and filtering said liquid medium to separate said aggregates from said liquid medium.

15. The process of claim 14, including the further step
10 of oxidizing said aggregates in a reaction medium to release said heavy metal ions and form aggregates comprising dimers of said surfactant compounds linked by a disulfide bond between their central head groups; separating the dimer-containing aggregate from said 15 reaction medium; regenerating said surfactant compound from said dimers; and recycling said surfactant compounds to said process.

16. The process of claim 15, wherein said surfactant 20 compound is regenerated from said dimer by reacting said dimer with a reducing agent.